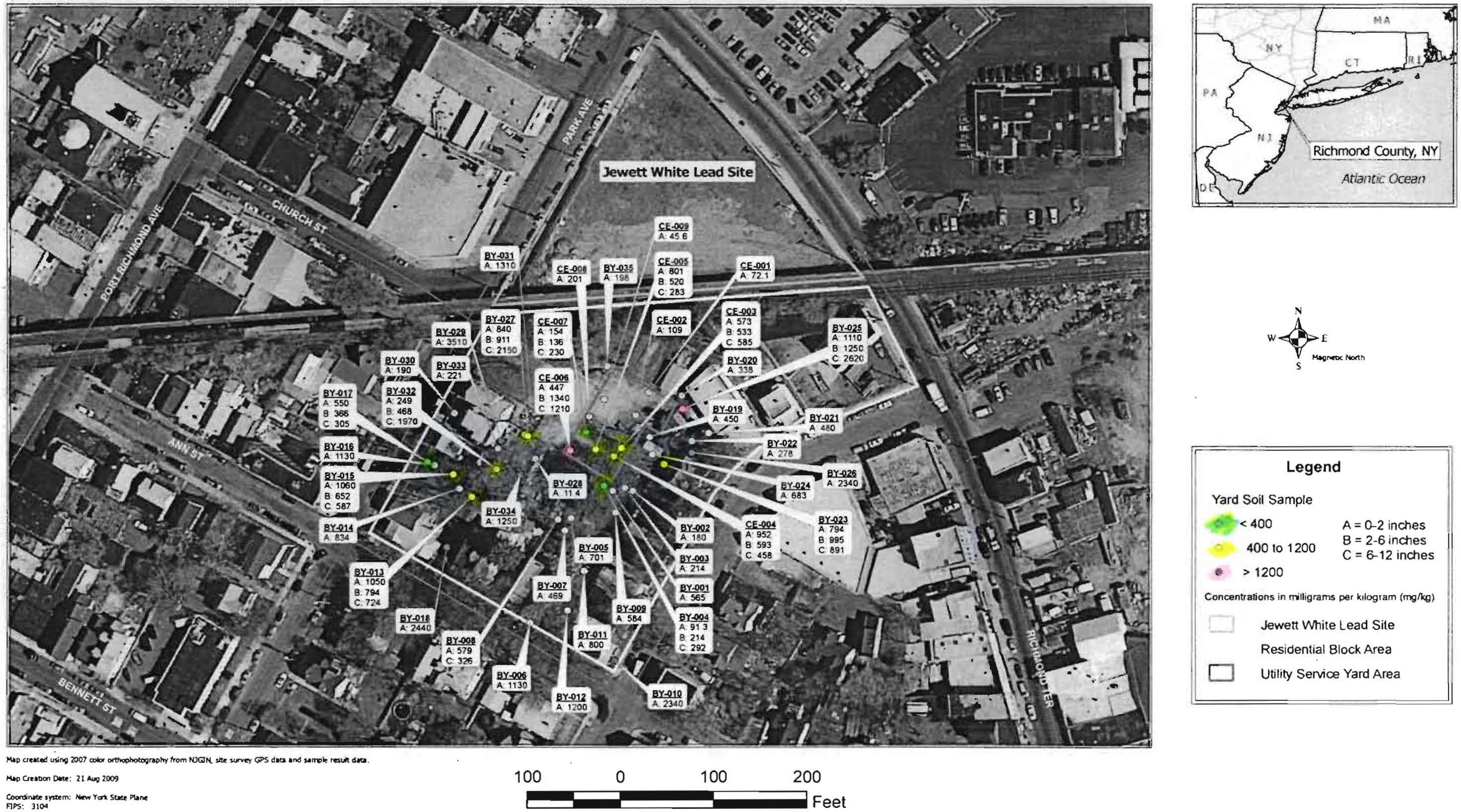
Attribution

Concentration Gradient = 2-6" depth



Map created using 2007 color orthophotography from NYSGIS, site survey GPS data and sample result data.

Map Creation Date: 21 Aug 2009

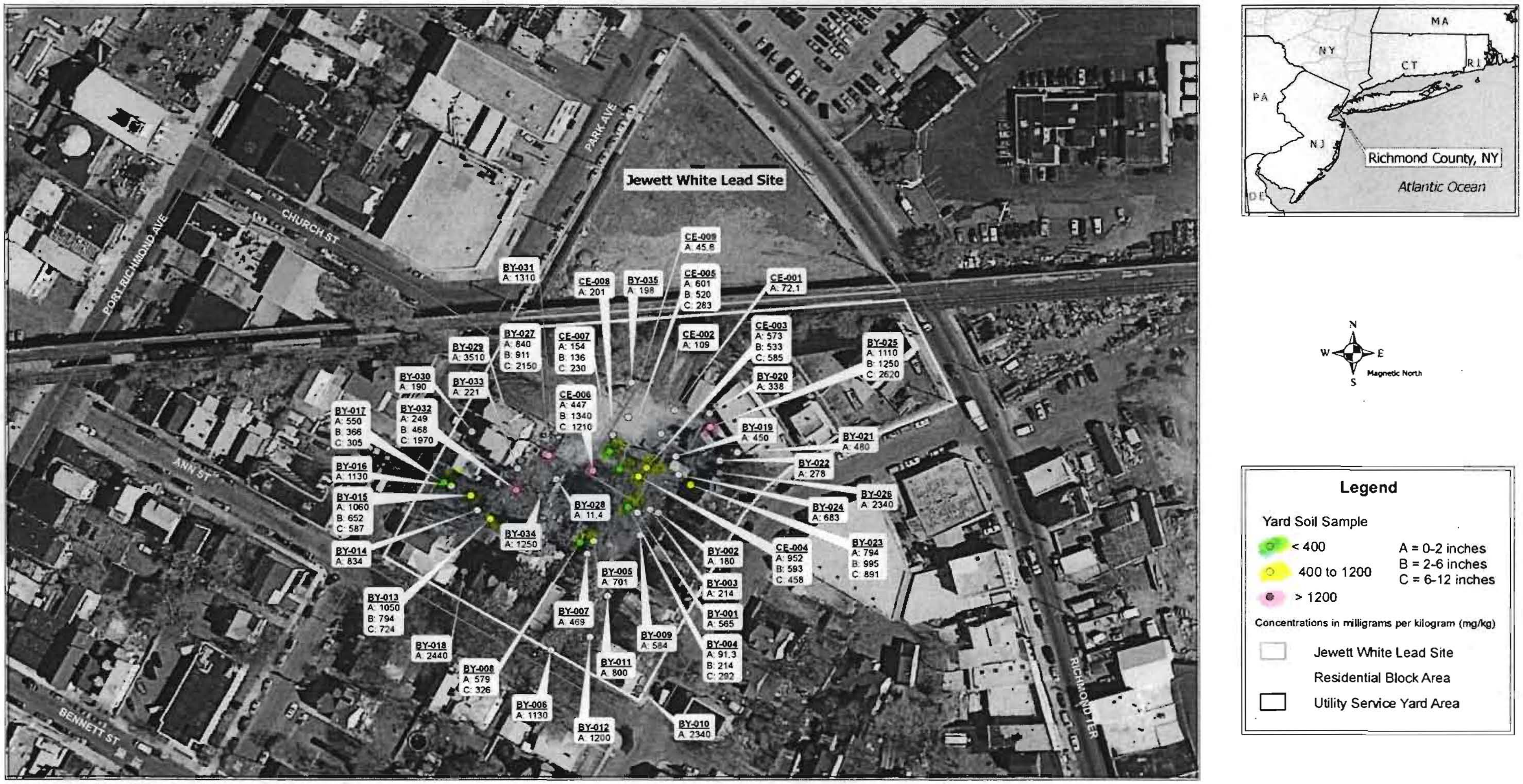
Coordinate system: New York State Plane
FIPS: 3104
Datum: NAD83
Units: Feet

Data: g:\arcviewprojects\reac4\00-388
MXD file: g:\arcinfoprojects\reac4\EAC00388_JewettWhiteLead_Site\388_Residential_Block_Sample_Lead_Result_f3rev001
Revision Number: 001

U.S. EPA Environmental Response Team
Response Engineering and Analytical Contract
EP-C-04-032
W.A.# 0-388

Figure 3
Residential Block Soil Lead Results
Jewett White Lead Site
Staten Island, New York
August, 2009

Concentration Gradient = 6-12" depth



Map created using 2007 color orthophotography from NYSGIS, site survey GPS data and sample result data.

Map Creation Date: 21 Aug 2009

Coordinate system: New York State Plane
FIPS: 3104
Datum: NAD83
Units: Feet

100 0 100 200 Feet

Data: g:\arcviewprojects\eac4\00-388
MXD file: g:\arcinfoprojects\eac4\EAC00388_JewettWhiteLead_Site\388_Residential_Block_Sample_Lead_Result_f3rev001
Revision Number: 001

U.S EPA Environmental Response Team
Response Engineering and Analytical Contract
EP-C-04-032
W.A.# 0-388

Figure 3
Residential Block Soil Lead Results
Jewett White Lead Site
Staten Island, New York
August, 2009

Sample ID	Type	Comment
BY-003A	Biased grab	Garden
BY-006A	Biased grab	Front yard play area
BY-007A	Biased grab	Area where resident was digging for pool
BY-008A+C	Biased grab	Near shed w/XRF confirmed Pb paint
BY-009A	Biased grab	Grab in backyd.
BY-010	Biased grab	Front yard play area – ~~in dripline~~ (front porch)
BY-011A	Biased grab	Grab in flower garden
BY-028A	Biased grab	Next to concrete shed wall (disturbed soil)
BY-029A	Biased grab	Drip line sample next to brick w/ XRF confirmed paint
BY-030A	Biased grab	front yd play area
BY-031A	Biased grab	back yd. grab sample
BY-034A	Biased grab	garden
BY-018A	Biased	dripline
BY-026A	Biased	dripline

ATTRIBUTION

- Looking at potential for other lead sources
  - Elevated rail line
  - Lead paint from older homes
  - Historic leaded gasoline emissions

- Using advanced science to "fingerprint" the lead from Jewett Site

- Using XAS (X-Ray Absorption Spectroscopy) at a syncotron facility (particle accelerator) to speciate the lead

- Lead (from lead paint/lead mines) found in soil, if left long enough will form lead carbonate or absorb other minerals from the soils/clay. White lead (hydroxycarbonate) is distinctly different

- Also looking at an elemental correlation between the lead at the site and other metals present in the site soils. Found a strong elemental correlation between site soils and off-site samples collected along Richmond Terrace.

Preliminary Report on the Analysis of the Staten Island Pb Data

Introduction

The analysis aimed at

1. whether there was statistically significant evidence for lead from the site in the backyard samples at concentrations of, on average, greater than 400ppm,
2. or whether there was statistically significant evidence for concentrations, on average, less than 400ppm,
3. or, if not, what further sampling would ensure a high probability of confidently inferring that the average concentration is less than 400ppm were there no lead from the site in the backyard samples.

The data used were soil concentrations and isotope ratios from samples taken at the site, from samples taken off-site at locations assumed uncontaminated, and from samples taken in back-yards near the site. Only the "color-coded" observations were used. The analysis plan focused on examining to what extent the back-yard samples appeared to represent a mixture of lead characterized by the samples at the site and lead characterized by the samples at the uncontaminated locations.

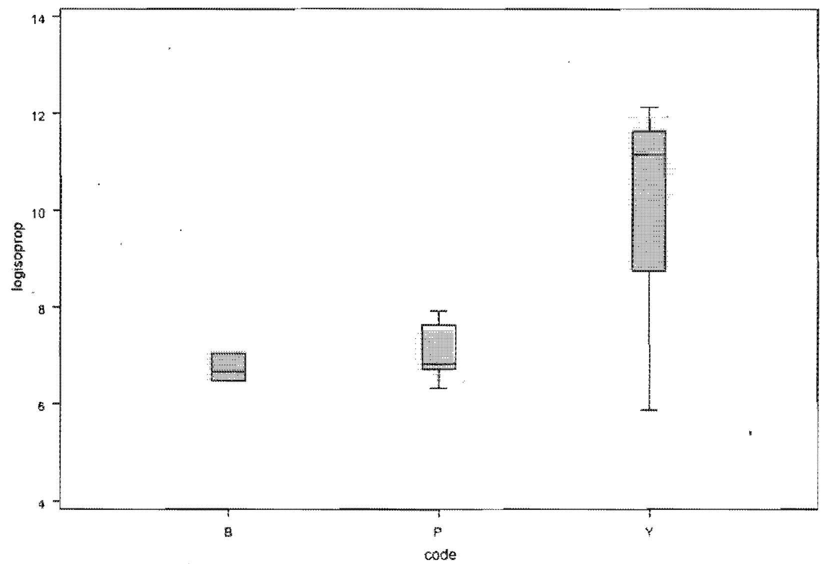
Data

The isotope ratio and concentration data used in the analysis are presented in Table 1. Concentrations of Pb206 and Pb208 together were computed as $C \times (r_1+r_2)/(1+ r_1+r_2)$, where C is the total measured concentration of lead, and r_1, r_2 are the 206/207 and 208/207 ratios. This calculation treats the presumably approximately 1% of Pb204 isotope as negligible. The values in the column labeled 'code' in the table represent the kind of sample, Y for onsite, P for back-yard, and B for uncontaminated.

r1	r2	ppm	code
2.393	1.122	90900	Y
2.390	1.117	240000	Y
2.397	1.126	147000	Y
2.400	1.125	8005	Y
2.411	1.138	456	Y
2.427	1.144	1250	P
2.439	1.160	3510	P
2.441	1.176	1020	B
2.451	1.180	1050	P
2.451	1.181	1110	P
2.453	1.179	841	B
2.454	1.184	1480	B
2.457	1.186	724	P
2.462	1.195	2620	P

The distribution of the log concentrations are depicted in Figure 1. It is evident from the figure that the concentrations in the site far exceed those in the other locations. But whether there is a difference between the back-ground and the back-yard samples is not obvious.

Figure 1.



Analysis

Let P denote the average concentration of Pb206 and Pb208 together off-site. Let Y denote the average concentration in backyards, and let q denote the proportion of PB206 and Pb208 in onsite lead. Let X denote the concentration of lead from onsite that is mixed in backyard samples. Then we have

$$P + qX - Y = 0.$$

We may estimate P using the average, in the uncontaminated sites, of the concentration of Pb206 and Pb208 together. We may estimate Y similarly from the back-yard sites. And we may estimate q from the concentrations in the onsite samples. The estimate of q may be adjusted for the presence of background lead, but because of the large concentrations onsite, the adjustment has minor impact on the results.

We may estimate q by solving the empirical version of the equation, and we may find a confidence interval for q by using the left hand side of the equation, normalized by its standard error, as a pivot statistic. Robust standard error computations that allow for different variances in the three samples were used in computing the standard errors that appear in the pivot statistic underlying the confidence interval.

Code for the analysis (in the SAS statistical package) is given below.

```
data data;
input name $ r1 r2 ppm code $;
datalines;
A-5-3 2.393 1.122 90900       Y
G-2-2 2.390 1.117 240000 Y
C-3-3 2.397 1.126 147000 Y
A-5-0 2.400 1.125 8005 Y
0-1 2.407 1.136 2760 0
B-2-0 2.411 1.138 456 Y
0-2 2.418 1.146 383    0
BY-034A 2.427 1.144 1250 P
TT-05A 2.436 1.168 396 0
BY-029A 2.439 1.160 3510 P
GP-38A 2.439 1.169 1070       0
GP-007B 2.441 1.176 1020 B
GP-008B 2.445 1.174 1330 0
TT-22A 2.448 1.179 2340       0
BY-13A 2.451 1.180 1050       P
BY-025A 2.451 1.181 1110 P
GP-006C 2.453 1.179 841       B
GP-006A 2.454 1.184 1480 B
BY-013C 2.457 1.186 724       P
GP-025A 2.461 1.196 1000 0
BY-025C 2.462 1.195 2620 P
;
run;
options mprint spool;
%macro m(start, by);
data data;
set data;
if code='0' then delete;
prop=(r1+r2)/(r1+r2+1);
P=0;
B=0;
Y=0;
if code='P' then P=1;
if code='B' then B=1;
if code='Y' then Y=1;
if code='Y' then z=prop;
if code='B' then z=prop*ppm;
if code='P' then z=prop*ppm;
run;
ods output acovtestanova=acovtestanova;
proc reg data=data;
model z= P B Y / noint hcc hccmethod=1;
%do i = &start %to 0 %by -&by;
testneg&i: test P-B+&i*Y = 0;
%end;
%do i = &by %to &start %by &by;
testpos&i: test P-B-&i*Y = 0;
%end;
run;
data acovtestanova;
set acovtestanova;
retain index -&start;
index=index+&by;
run;
%mend;
%m(2000, 10);
symbol1 color=black value=none interpol=join;
proc gplot data=acovtestanova;
plot probchisq*index;
run;
proc print data=acovtestanova;
where (abs(probchisq-0.05)<.0015) or (abs(probchisq-1.0)<0.008);
run;
```

Results

The value of X that solves the estimating equation is approximately 610ppm. The 90% two-sided confidence interval extends from 0ppm to 1580ppm; the two-sided p-value for testing that X=400 is 0.67, so that we may estimate the standard error of the estimate as (610-400)/0.44 = 477. Thus we cannot rule out that there is more than 400pm, on average, contamination from the site, but there certainly is not statistically significant evidence that there is 400ppm or more.

In order to have power 0.9 to reject the one-sided null hypothesis that X exceeds 400ppm when the true value of X is zero at level 0.95, we set the standard error of X multiplied by 1.65+1.29 to 400 to obtain approximately 133. The ratio of 477 to 133 is approximately 3.5. Squaring 3.5, we arrive at requiring that the sample size be increased by a factor of 12. That is, there should be, instead of the 14 observations used, approximately 170 observations.

Michael Pribil
USGS Minerals
Building 20, MS 973
Denver Federal Center
Denver, CO 80225

8 September 2009

Summary of the Pb isotopic composition of Jewett soil samples analyzed August and Sept 2009.

Two separate sets of soil samples from Staten Island, NY were analyzed for Pb isotopic composition. The first set of samples (A-5-3, B-2-0, G-2-2, C-3-3, 0-1, 0-2) were prepped by EPA NEIC Denver, CO and analyzed 4-7 August 2009 on the USGS Nu Instruments Multi-collector ICP-MS, located in the high resolution ICP-MS lab, USGS Minerals, Denver, CO. The second set of samples (TT-05C, TT-22A, GP-006A, GP-006C, GP-007B, GP-008B, GP-025A, GP-038A, BY-13A, BY-13C, BY-25A, BY-25C, BY-29A, BY-034A, A-5-0) were received 25 August 2009 and prepped by Michael Pribil, USGS according to US EPA protocol provided by EPA NEIC Denver and analyzed on 3 Sep 2009 on the same instrument as the first set of samples. The Pb was extracted from the soil and an aliquot required for a final Pb concentration of approximately 10 ppb was brought to dryness, reconstituted in 2M HCl and loaded on an Eichrom Sr specific resin columns to separate Pb from the soil matrix. The matrix was eluted by successive 0.5 and 1 ml elutions with 2M HCl (4ml total). Pb was eluted from the columns using a 6ml of 6M HCl. The eluent was brought to dryness and reconstituted in 5ml of 2% HNO_3. All samples were spiked with NIST SRM 997 Tl isotope standard for internal mass bias correction. NIST SRM 981was analyzed after every three samples. Random samples were prepped and analyzed in triplicate, with other samples reanalyzed on different days.

Results for NIST SRM 981 during the two separate analyses and for samples ran in triplicate are as follows:

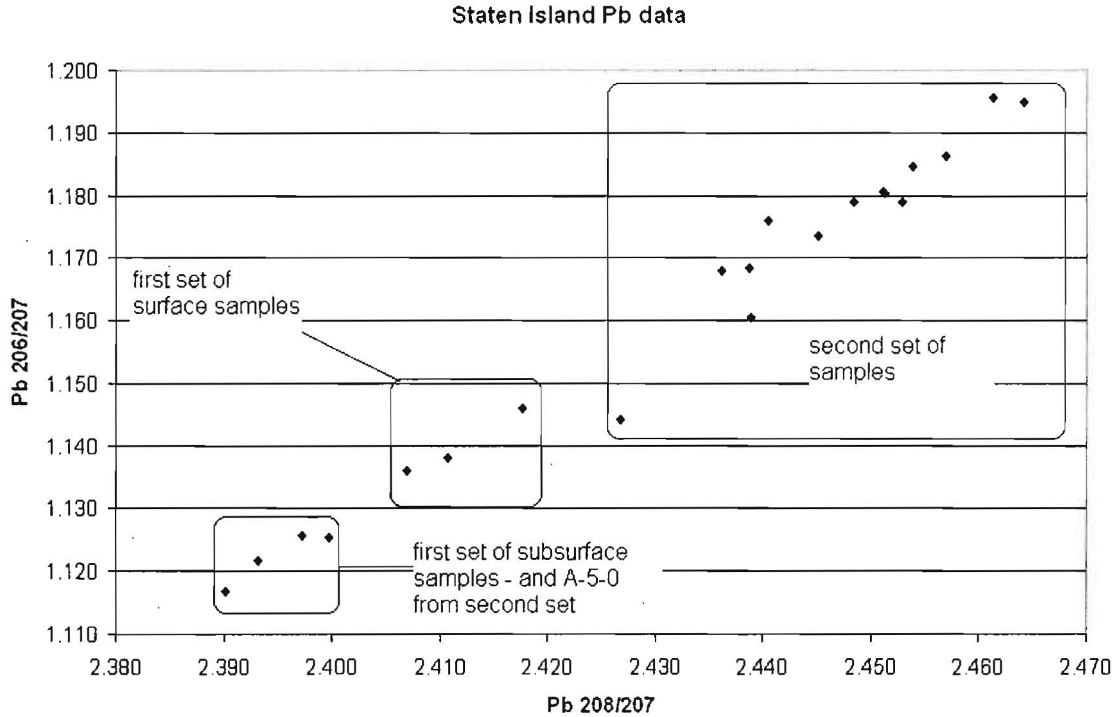
	Pb 208/207		Pb 206/207	
	AVG	STD	AVG	STD
NIST SRM 981 (n=21) Over all days of analyses	2.370	0.001	1.095	0.001
Samples processed in triplicate				
	AVG	STD	AVG	STD
0-2 (n=5)	2.418	0.002	1.146	0.002
G-2-2(n=3)	2.390	0.001	1.117	0.001

It is impossible to correlate Pb to a single source using isotope ratios without knowing the isotopic composition of the source and other background Pb inputs. In urban environments many sources exist for Pb, including automobile, Municipal Waste Incineration, oil & gas refineries, fertilizer plants, Pb based paints, deteriorating paint on steel structures, demolition of city structures, and re-suspension and re-mobilization of Pb. Many of the mentioned sources for Pb exist in and around the Staten Island area. Figure 1 illustrates separate relationships for the 21 samples. The subsurface samples are distinct from the surface samples and the samples from the second set (except sample A-5-0). The second set of samples (minus A-5-0) plot distinctly in figure 1 and are similar in Pb 206/207 ratios as other published Pb isotopic analyses in the New York City (Carvanos et al., 2009) and Jersey City (Adgate et al., 1998). Carvanos et al. published Pb 206/207 isotopes measured for boroughs in New York City in 2003-2004 determined in dust wipes on pedestrian traffic signals. They included Staten Island in their study, however they did not publish any isotopic data for that borough, the other boroughs resulted in a Pb 206/207 range of 1.172 to 1.222. Adgate et al. study reported Jersey City soils with a range of Pb 206/207 from 1.155 to 1.200 and street dust Pb 206/207 ranging from 1.155 to 1.200. The second set of EPA samples analyzed resulted in a range of 1.160 to 1.196 for Pb 206/207, which is similar to both Pb isotopic composition studies published for New York City and Jersey City. The Pb concentration in the soils for the Jersey City study ranged from 70 ppm to 2080 ppm and for the street dust Pb ranged from 370 ppm to 1840 ppm with the second set of EPA samples ranging from 724 ppm to 3510 ppm Pb (not including A-5-0). It is important to note that Carvanos et al. reported that a Staten Island hot spot in their study was adjacent to a large land fill comprised of uncovered soil and Word Trade Center debris. They also mention the prevailing winds (west to east) from the industrial areas of New Jersey as a potential source for Pb.

Table 1

sample ID	Pb 208/207	Pb 206/207
A-5-3	2.393	1.122
G-2-2	2.390	1.117
C-3-3	2.397	1.126
A-5-0	2.400	1.125
0-1	2.407	1.136
B-2-0	2.411	1.138
0-2	2.418	1.146
BY-034A	2.427	1.144
TT-05A	2.436	1.168
BY-029A	2.439	1.160
GP-38A	2.439	1.169
GP-007B	2.441	1.176
GP-008B	2.445	1.174
TT-22A	2.448	1.179
BY-13A	2.451	1.180
BY-025A	2.451	1.181
GP-006C	2.453	1.179
GP-006A	2.454	1.184
BY-013C	2.457	1.186
GP-025A	2.461	1.196
BY-025C	2.464	1.195

Figure 1. Pb 208/207 vs Pb 206/207 plot



References:

Adgate, J.L., Roads, G.G., Lioy, P.J., 1998. The use of isotope ratios to apportion sources of lead in Jersey City, NJ, house dust wipe samples. The Science of the Total Environment 22, 171-180

Caravanos, J. Weiss, A.L., Blaise, M.J., Jaeger, R.J.. 2009, A survey of spatially distributed exterior dust lead loadings in New York City. Environmental Research, Article in press.